

What is claimed is:

1. A color filter array comprising a unit array, the unit array having green, red, blue, and infrared pass filters in the relative proportions of 4:1:1:2, respectively.

2. A color filter array comprising:

a first row of pass filters, comprising, in order, blue, green, red, and green pass filters;

a second row of pass filters, comprising, in order, green, infrared, green, and infrared pass filters, wherein the second row of pass filters is adjacent to the first row of pass filters so that the blue pass filter of the first row is adjacent to the first green pass filter of the second row;

a third row of pass filters, comprising, in order, red, green, blue, and green pass filters, wherein the first green pass filter of the second row is adjacent to the red pass filter of the third row; and

a fourth row of pass filters, comprising, in order, green, infrared, green, and infrared pass filters, wherein the red pass filter of the third row is adjacent to the first green pass filter of the fourth row.

3. A color filter array comprising an array of pass filters $f_{i,j}$ wherein for some n and m :

$f_{n+1,m+1}$ and $f_{n+3,m+3}$ are blue pass filters;

$f_{n+1,m+2}$, $f_{n+1,m+4}$, $f_{n+2,m+1}$, $f_{n+2,m+3}$, $f_{n+3,m+2}$, $f_{n+3,m+4}$, $f_{n+4,m+1}$, and $f_{n+4,m+3}$ are green pass filters;

$f_{n+1,m+3}$ and $f_{n+3,m+1}$ are red pass filters; and

$f_{n+2,m+2}$, $f_{n+2,m+4}$, $f_{n+4,m+2}$, and $f_{n+4,m+4}$ are infrared pass filters.

4. An imaging system comprising:

a color filter array comprising an array of pass filters f wherein for some n and m :

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- $f_{n+1,m+1}$ and $f_{n+3,m+3}$ are blue pass filters;
 $f_{n+1,m+2}$, $f_{n+1,m+4}$, $f_{n+2,m+1}$, $f_{n+2,m+3}$, $f_{n+3,m+2}$, $f_{n+3,m+4}$, $f_{n+4,m+1}$, and $f_{n+4,m+3}$ are green
pass filters;
 $f_{n+1,m+3}$ and $f_{n+3,m+1}$ are red pass filters;
5 $f_{n+2,m+2}$, $f_{n+2,m+4}$, $f_{n+4,m+2}$, and $f_{n+4,m+4}$ are infrared pass filters; and
an array of pixel sensors responsive to electromagnetic radiation propagating
through the color filter array, wherein for some range of position indices u and v , a pixel
sensor at position (u, v) provides an output signal $X(u, v)$ indicative of electromagnetic
radiation propagating through the color filter array and impinging upon the pixel sensor at
10 position (u, v) .
5. The imaging system as set forth in claim 4, further comprising
at least one processor to provide interpolated color component signals $\hat{X}_i(u, v)$, i
 $= 1, 2, 3$, where $i = 1$ denotes red, $i = 2$ denotes green, and $i = 3$ denotes blue, wherein for
15 each $i = 1, 2, 3$; if $X(u, v)$ is an output signal of a color i pixel sensor, then
 $\hat{X}_i(u, v) = X(u, v)$, and if $X(u, v)$ is an output signal of an IR pixel sensor or a color
 $j \neq i$ pixel sensor, then $\hat{X}_i(u, v)$ is an average of the output signals of nearest neighbor
color i pixel sensors.
- 20 6. The imaging system as set forth in claim 4, further comprising
a memory storage device, wherein stored in the memory storage device are
instructions to process interpolated color component signals $\hat{X}_i(u, v)$, $i = 1, 2, 3$, where i
 $= 1$ denotes red, $i = 2$ denotes green, and $i = 3$ denotes blue, wherein for each $i = 1, 2, 3$; if
 $X(u, v)$ is an output signal of a color i pixel sensor, then $\hat{X}_i(u, v) = X(u, v)$, and if
25 $X(u, v)$ is an output signal of an IR pixel sensor or a color $j \neq i$ pixel sensor,
then $\hat{X}_i(u, v)$ is an average of the output signals of nearest neighbor color i pixel sensors.

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Patent # 6,367,660

7. A method to interpolate color component signals, comprising:
providing a color filter array comprising
a first row of pass filters, comprising, in order, blue, green, red, and green
pass filters;
5 a second row of pass filters, comprising, in order, green, infrared, green,
and infrared pass filters, wherein the second row of pass filters is adjacent to the first row
of pass filters so that the blue pass filter of the first row is adjacent to the first green pass
filter of the second row;
a third row of pass filters, comprising, in order, red, green, blue, and green
10 pass filters, wherein the first green pass filter of the second row is adjacent to the red pass
filter of the third row; and
a fourth row of pass filters, comprising, in order, green, infrared, green,
and infrared pass filters, wherein the red pass filter of the third row is adjacent to the first
green pass filter of the fourth row;
15 providing an array of pixel sensors responsive to electromagnetic radiation
propagating through the color filter array, wherein for some range of position indices u
and v , a pixel sensor at position (u, v) provides an output signal $X(u, v)$ indicative of
electromagnetic radiation propagating through the color filter array and impinging upon
the pixel sensor at position (u, v) ; and
20 interpolating to provide interpolated color component signals $\hat{X}_i(u, v)$, $i = 1, 2, 3$,
where $i = 1$ denotes red, $i = 2$ denotes green, and $i = 3$ denotes blue, wherein for each $i =$
 $1, 2, 3$; if $X(u, v)$ is an output signal of a color i pixel sensor, then $\hat{X}_i(u, v) = X(u, v)$,
and if $X(u, v)$ is an output signal of an IR pixel sensor or a color $j \neq i$ pixel sensor,
then $\hat{X}_i(u, v)$ is an average of the output signals of nearest neighbor color i pixel sensors.
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8. A method to interpolate color component signals, comprising:
providing a color filter array comprising
a color filter array comprising an array of pass filters f wherein for some n
and m :

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11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

$f_{n+1,m+1}$ and $f_{n+3,m+3}$ are blue pass filters;

$f_{n+1,m+2}$, $f_{n+1,m+4}$, $f_{n+2,m+1}$, $f_{n+2,m+3}$, $f_{n+3,m+2}$, $f_{n+3,m+4}$, $f_{n+4,m+1}$, and $f_{n+4,m+3}$ are green pass filters;

$f_{n+1,m+3}$ and $f_{n+3,m+1}$ are red pass filters; and

5 $f_{n+2,m+2}$, $f_{n+2,m+4}$, $f_{n+4,m+2}$, and $f_{n+4,m+4}$ are infrared pass filters;

providing an array of pixel sensors responsive to electromagnetic radiation propagating through the color filter array, wherein for some range of position indices u and v , a pixel sensor at position (u, v) provides an output signal $X(u, v)$ indicative of electromagnetic radiation propagating through the color filter array and impinging upon the pixel sensor at position (u, v) ; and

10 interpolating to provide interpolated color component signals $\hat{X}_i(u, v)$, $i = 1, 2, 3$, where $i = 1$ denotes red, $i = 2$ denotes green, and $i = 3$ denotes blue, wherein for each $i = 1, 2, 3$; if $X(u, v)$ is an output signal of a color i pixel sensor, then $\hat{X}_i(u, v) = X(u, v)$, and if $X(u, v)$ is an output signal of an IR pixel sensor or a color $j \neq i$ pixel sensor,

15 then $\hat{X}_i(u, v)$ is an average of the output signals of nearest neighbor color i pixel sensors.

9. A color filter array comprising a unit array, the unit array having yellow, magenta, cyan, and infrared pass filters in the relative ^{proportions} ratios of 4:1:1:2, respectively.

20 10. A color filter array comprising:

a first row of pass filters, comprising, in order, cyan, yellow, magenta, and yellow pass filters;

a second row of pass filters, comprising, in order, yellow, infrared, yellow, and infrared pass filters, wherein the second row of pass filters is adjacent to the first row of pass filters so that the cyan pass filter of the first row is adjacent to the first yellow pass filter of the second row;

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a third row of pass filters, comprising, in order, magenta, yellow, cyan, and yellow pass filters, wherein the first yellow pass filter of the second row is adjacent to the magenta pass filter of the third row; and

- 5 a fourth row of pass filters, comprising, in order, yellow, infrared, yellow, and infrared pass filters, wherein the magenta pass filter of the third row is adjacent to the first yellow pass filter of the fourth row.

11. A color filter array comprising an array of pass filters $f_{i,j}$ wherein for some n and m :

10 $f_{n+1,m+1}$ and $f_{n+3,m+3}$ are cyan pass filters;

$f_{n+1,m+2}$, $f_{n+1,m+4}$, $f_{n+2,m+1}$, $f_{n+2,m+3}$, $f_{n+3,m+2}$, $f_{n+3,m+4}$, $f_{n+4,m+1}$, and $f_{n+4,m+3}$ are yellow pass filters;

$f_{n+1,m+3}$ and $f_{n+3,m+1}$ are magenta pass filters; and

$f_{n+2,m+2}$, $f_{n+2,m+4}$, $f_{n+4,m+2}$, and $f_{n+4,m+4}$ are infrared pass filters.

15 12. An imaging system comprising:

a color filter array comprising an array of pass filters f wherein for some n and m :

$f_{n+1,m+1}$ and $f_{n+3,m+3}$ are cyan pass filters;

$f_{n+1,m+2}$, $f_{n+1,m+4}$, $f_{n+2,m+1}$, $f_{n+2,m+3}$, $f_{n+3,m+2}$, $f_{n+3,m+4}$, $f_{n+4,m+1}$, and $f_{n+4,m+3}$ are yellow

20 pass filters;

$f_{n+1,m+3}$ and $f_{n+3,m+1}$ are magenta pass filters;

$f_{n+2,m+2}$, $f_{n+2,m+4}$, $f_{n+4,m+2}$, and $f_{n+4,m+4}$ are infrared pass filters; and

25 an array of pixel sensors responsive to electromagnetic radiation propagating through the color filter array, wherein for some range of position indices u and v , a pixel sensor at position (u,v) provides an output signal $X(u,v)$ indicative of electromagnetic radiation propagating through the color filter array and impinging upon the pixel sensor at position (u,v) .

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13. The imaging system as set forth in claim 12, further comprising
at least one processor to provide interpolated color component signals $\hat{X}_i(u, v)$, i
 $= 1, 2, 3$, where $i = 1$ denotes magenta, $i = 2$ denotes yellow, and $i = 3$ denotes cyan,
wherein for each $i = 1, 2, 3$; if $X(u, v)$ is an output signal of a color i pixel sensor, then
5 $\hat{X}_i(u, v) = X(u, v)$, and if $X(u, v)$ is an output signal of an IR pixel sensor or a color
 $j \neq i$ pixel sensor, then $\hat{X}_i(u, v)$ is an average of the output signals of nearest neighbor
color i pixel sensors.
14. The imaging system as set forth in claim 12, further comprising
10 a memory storage device, wherein stored in the memory storage device are
instructions to process interpolated color component signals $\hat{X}_i(u, v)$, $i = 1, 2, 3$, where i
 $= 1$ denotes magenta, $i = 2$ denotes yellow, and $i = 3$ denotes cyan, wherein for each $i = 1,$
 $2, 3$; if $X(u, v)$ is an output signal of a color i pixel sensor, then $\hat{X}_i(u, v) = X(u, v)$, and if
 $X(u, v)$ is an output signal of an IR pixel sensor or a color $j \neq i$ pixel sensor,
15 then $\hat{X}_i(u, v)$ is an average of the output signals of nearest neighbor color i pixel sensors.
15. A method to interpolate color component signals, comprising:
providing a color filter array comprising
a first row of pass filters, comprising, in order, cyan, yellow, magenta, and
20 yellow pass filters;
a second row of pass filters, comprising, in order, yellow, infrared, yellow,
and infrared pass filters, wherein the second row of pass filters is adjacent to the first row
of pass filters so that the cyan pass filter of the first row is adjacent to the first yellow pass
filter of the second row;
25 a third row of pass filters, comprising, in order, magenta, yellow, cyan, and
yellow pass filters, wherein the first yellow pass filter of the second row is adjacent to the
magenta pass filter of the third row; and

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a fourth row of pass filters, comprising, in order, yellow, infrared, yellow, and infrared pass filters, wherein the magenta pass filter of the third row is adjacent to the first yellow pass filter of the fourth row;

providing an array of pixel sensors responsive to electromagnetic radiation
5 propagating through the color filter array, wherein for some range of position indices u and v , a pixel sensor at position (u, v) provides an output signal $X(u, v)$ indicative of electromagnetic radiation propagating through the color filter array and impinging upon the pixel sensor at position (u, v) ; and

interpolating to provide interpolated color component signals $\hat{X}_i(u, v)$, $i = 1, 2, 3$,
10 where $i = 1$ denotes magenta, $i = 2$ denotes yellow, and $i = 3$ denotes cyan, wherein for each $i = 1, 2, 3$; if $X(u, v)$ is an output signal of a color i pixel sensor, then $\hat{X}_i(u, v) = X(u, v)$, and if $X(u, v)$ is an output signal of an IR pixel sensor or a color $j \neq i$ pixel sensor, then $\hat{X}_i(u, v)$ is an average of the output signals of nearest neighbor color i pixel sensors.

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16. A method to interpolate color component signals, comprising:

providing a color filter array comprising

a color filter array comprising an array of pass filters f wherein for some n and m :

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$f_{n+1, m+1}$ and $f_{n+3, m+3}$ are cyan pass filters;

$f_{n+1, m+2}$, $f_{n+1, m+4}$, $f_{n+2, m+1}$, $f_{n+2, m+3}$, $f_{n+3, m+2}$, $f_{n+3, m+4}$, $f_{n+4, m+1}$, and $f_{n+4, m+3}$ are yellow pass filters;

$f_{n+1, m+3}$ and $f_{n+3, m+1}$ are magenta pass filters; and

$f_{n+2, m+2}$, $f_{n+2, m+4}$, $f_{n+4, m+2}$, and $f_{n+4, m+4}$ are infrared pass filters;

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providing an array of pixel sensors responsive to electromagnetic radiation propagating through the color filter array, wherein for some range of position indices u and v , a pixel sensor at position (u, v) provides an output signal $X(u, v)$ indicative of

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electromagnetic radiation propagating through the color filter array and impinging upon the pixel sensor at position (u, v) ; and

- interpolating to provide interpolated color component signals $\hat{X}_i(u, v)$, $i = 1, 2, 3$, where $i = 1$ denotes magenta, $i = 2$ denotes yellow, and $i = 3$ denotes cyan, wherein for each $i = 1, 2, 3$; if $X(u, v)$ is an output signal of a color i pixel sensor, then
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$\hat{X}_i(u, v) = X(u, v)$, and if $X(u, v)$ is an output signal of an IR pixel sensor or a color $j \neq i$ pixel sensor, then $\hat{X}_i(u, v)$ is an average of the output signals of nearest neighbor color i pixel sensors.